

THE WATERBIRDS OF PULICAT LAKE, ANDHRA PRADESH-TAMIL NADU, INDIA, INCLUDING THOSE OF THE ADJOINING WETLANDS AND HERONRIES

V. KANNAN^{1,5}, RANJIT MANAKADAN^{1,6}, PRAKASH RAO², K.K. MOHAPATRA³, S. SIVAKUMAR^{1,7} AND V. SANTHARAM⁴

¹Bombay Natural History Society, Hornbill House, S.B. Singh Road, Mumbai 400 001, Maharashtra, India.

²WWF – India, 172-B, Lodi Estate, New Delhi 110 003, India. Email: PRao@wwfindia.net

³JPS Associates Private Limited, R-16 Hauz Khas Enclave, New Delhi 110 016, India.

Email: kk.mohapatra@ipsconsultantsindia.com

⁴Institute of Bird Studies & Natural History, Rishi Valley Education Centre, Rishi Valley 517 352, Chittoor district, Andhra Pradesh, India. Email: birds@rishivalley.org

⁵Email: kannan.vaithianathan@gmail.com

⁶Email: ransan5@rediffmail.com

⁷Email: sivaprema3sep@yahoo.com

This paper provides an account of the waterbirds of Pulicat lake based primarily on findings of a 3-year study (December 2004 to November 2007) that covered the entire expanse of the Pulicat lake and supplemented by records of earlier workers. It also describes the waterbirds occurring in the adjoining heronries and freshwater wetlands, thus providing a comprehensive account of the avifauna of the Pulicat lake area. The status, distribution and abundance of 113 waterbird species (both resident and migratory) from the Pulicat lake area are discussed.

Key words: waterbirds, Pulicat lake, Nelapattu, Sriharikota, Kudiri tank, heronries

INTRODUCTION

Pulicat is the second largest brackish water lagoon after Chilika (Orissa) in India and one of the most important refuges for waterbirds in southern India (Scott 1989; Perennou and Santharam 1990; Santharam 1993, 1998; Samant and Rao 1996; Rao 1998; Balachandran 1998; Anon 1993; Manakadan and Kannan 2003). There are also a number of heronries and wetlands in the Pulicat area (Nagulu 1983; Krishnan 1990; Perennou and Santharam 1990; Ramakrishna 1990, 1996; Santharam 1993, 1998; Philip 1995; Philip *et al.* 1998; Subramanya 1996a, 1996b; Samant and Rao 1996; Sharma, and Raghavaiah 2000, 2002; Manakadan and Kannan 2003; Manakadan and Sivakumar 2004a; Kannan and Manakadan 2005; Sivakumar and Manakadan 2005). Because of its importance to waterbirds, Pulicat is identified as an Important Bird Area (IBA) site of India by the BirdLife International and the Bombay Natural History Society (Islam and Rahmani 2004). For these and other reasons, Pulicat has also been proposed for inclusion as a Ramsar Site by the Wetlands International.

Almost all the previous available information on the waterbirds of Pulicat is based on the studies and surveys from its central region (i.e., along the Sullurpet-Sriharikota road stretch and Tada area). The only study that covered the entire expanse of Pulicat lake pertains to a single species, the Spot-billed Pelican *Pelecanus philippensis* (Manakadan and Kannan 2003; Kannan and Manakadan 2005). Hence, there were lacunae in the information on the distribution, species composition, abundance and conservation issues related to

the waterbirds in the other parts, and this was the genesis of the study taken up by the first two authors (Manakadan and Kannan 2007). In order to obtain a more complete profile of the waterbirds of the Pulicat area, we also collected data on the heronries and more important wetlands in the area. All the data collected were supplemented with published and unpublished information of earlier workers: Prakash Rao and K.K. Mohapatra had worked in the Pulicat area from 1990 to 1994 (Samant and Rao 1996; Rao 1998; Balachandran 1998). S. Sivakumar had worked in the Pulicat area from 2001 to 2003 (Manakadan and Sivakumar 2004a). V. Santharam banded in the Pulicat area during 31 visits spread over a period of about 27 years and was a part of the BNHS Bird Migration Project in the Pulicat area from January 1990 to April 1990.

STUDY AREA

Pulicat lake (13° 24'-13° 47' N; 80° 03'- 80° 18' E) is situated in the states of Andhra Pradesh and Tamil Nadu in Nellore and Tiruvallur districts respectively. It encompasses an area of 720 sq. km (Scott 1989), of which 84% falls in Andhra Pradesh and the remaining 16% in Tamil Nadu (Fig. 1). The lagoon is about 60 km in length and its breadth varies from 0.2 to 17.5 km. The lake is comparatively shallow with an average depth of a little over a metre, with a north to south and west to east slope. The maximum depth of the lake is at the southern part, c. 7 m. During the dry season, water is generally present only in the southern lagoon part of Pulicat and near the two openings into the Bay of Bengal in the northern areas. The other areas may receive inflows from the

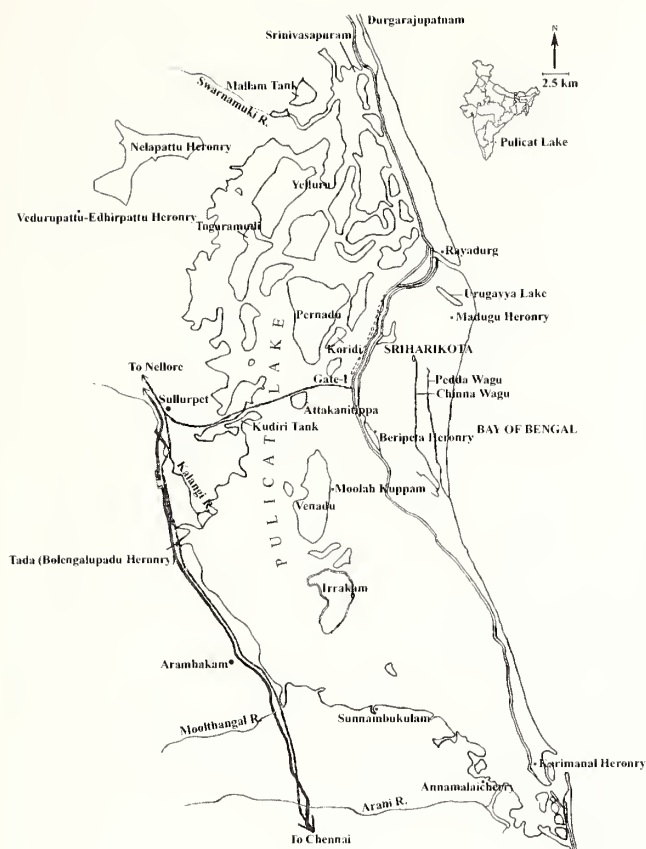


Fig. 1: Pulicat lake and its adjoining areas

Bay of Bengal during spring tides, especially when aided by strong winds.

Pulicat has three major openings into the Bay of Bengal, the largest being at the southern end of the Sriharikota Island, another at the northern tip of the Sriharikota Island and the third at the extreme northern part near Durgarajapatnam. The Buckingham Canal traverses in a north to south direction along the eastern edge of Pulicat and along Sriharikota island. The rivers Swarnamukhi and Kalangi in the northern part and the Arani and Moolthangal in the southern part drain into the lake during the monsoon season, causing an increase in water levels and a lowering of salinity. Pulicat has 20 islands, the largest being Sriharikota Island (c. 181 sq. km) at its eastern edge, which serves as the base for India's spaceport, the Satish Dhawan Space Centre-SHAR (SDSC-SHAR). The other large islands are Pernadu, Irrakam and Venadu. These islands have deposits of sub-fossilised lime shell. The islands are of recent origin in the geological time-scale, and are nothing more than low ridges of sand with the marine and aeolian deposits rising only a few metres above the sea level. Some of these islands are now connected to one another and/or to the mainland by roads cutting into the lake.

The rainfall in the region is largely from the North-east Monsoon (October-December). Very little rainfall is received during the South-west Monsoon (June-September). Pulicat is often exposed to extreme weather events like depressions and cyclones, usually in the early part of May and October, during the onset of the two monsoons. The annual rainfall is c. 1,200 mm. December to February is the winter season, with temperatures as low as 10 °C. March to September is the summer season, with temperatures soaring over 40 °C. A cool breeze blowing from the sea and from Pulicat gives some relief during the summer months. The wind throughout the major part of the year is from the south-west. The relative humidity is lowest during May (18%), while the maximum (99%) is recorded during October (source: Meteorological Department, SDSC-SHAR).

Paleobotanical studies show that a luxuriant mangrove forest flourished in Pulicat between 1450 and 1800 A.D., the peak being between 1450 and 1590. The remnants of mangrove vegetation are still seen in small patches in some areas of Pulicat, which is otherwise now bereft of mangrove vegetation. Sriharikota Island, well protected as it is a restricted area under the control of the Indian Space Research Organisation (ISRO), has remnants of the tropical dry evergreen forest of considerable botanical interest. On the other islands in the lake, where protection is negligible, the exotic *Prosopis chilensis* has invaded many areas. In the elevated mudflats, succulent halophytes, such as *Anthrocnemum indicus*, *Sesuvium portulacastrum*, *Salicornia brachiata*, *Suaeda maritima*, *Suaeda monoica* and *Suaeda nudiflora* occur. Submergent macrophytes of *Enteromorpha*, *Hypnea*, *Ulva*, *Halophila* and *Enhalus* occur in the southern lagoon part of Pulicat lake (Anon 1908; Hornell 1908; Chacko *et al.* 1953; Blasco and Legris 1973; Joel 1973; Kaliyamurthy 1972, 1973, 1974; Paul Raj 1976; Srinivasan and Pillay 1972; Raman *et al.* 1977; Thangavelu 1983; Oswin 1987; Scott 1989; Suryanarayana *et al.* 1989, 1998; Krishnan 1990; Kasappa 1991; Anon 1993; Ramesh 1994; Panini 1996; Sanjeeva Raj 1995-96, 1996; Vaz and Banerjee 1997; Manakadan and Kannan 2003, 2007; Manakadan and Sivakumar 2004a).

There are a number of water bodies and heronries along the western edges of Pulicat and the islands in Pulicat lake, some of which are important for migratory and resident waterbirds and where bird censuses were carried out during this study or earlier studies as follows.

Kudiri Tank: Kudiri Tank (20 ha) is located along the Sullurpet-Sriharikota road c. 4 km from Sullurpet. It is a shallow freshwater tank and turns brackish as it dries. The tank belongs to the Irrigation Department of Sullurpet Mandal. The major vegetation is of reed beds. The tank is surrounded by agricultural fields and is used for irrigation.

Koridi: Koridi tank (3.3 ha) is situated in Pernadu Island of Pulicat lake near Koridi village. Koridi is a shallow wetland, which becomes brackish as it dries due to its proximity to Pulicat lake. The tank has water till winter and has reed beds. The tank is surrounded by agricultural fields, which draw water from the tank.

Mallam Tank: Mallam tank (93 ha) is located in the northern part of Pulicat lake area near Mallam, a small town. The depth of the tank is about 2 m. It is a typical freshwater tank under the administration of the Irrigation Department. The major vegetation of the tank is the exotic *Ipomoea carnea*. Along the bunds, there are large trees of *Acacia nilotica*, *Azadirachta indica* and *Borassus flabellifer*.

Urugayya Lake: Urugayya lake, also known as Choladoruvu, is situated in the north-eastern part of Sriharikota Island. It has an expanse of about one square kilometer and is more or less perennial, having dried on only two occasions during the last five decades. The water is clear and brackish, and devoid of aquatic vegetation and has a maximum depth of 4 m. The salinity increases considerably during the summer months averaging that of sea water. Almost freshwater conditions prevail during the peak monsoon season. The excess water of Urugayya flows into the Bay of Bengal during the monsoon season via the Sateneru-Sidimuthu Kayya.

Pedda Wagu and Chinna Wagu: Pedda Wagu is the largest stream in Sriharikota Island, originating from the north-central part of the Island, it flows north to south and then turns eastwards to flow into the Bay of Bengal, traversing a distance of 15 km. The Chinna Wagu flows in a north to south direction parallel to the Pedda Wagu for about 9 km and has no outlet. Both the wagus have dense submergent and emergent aquatic vegetation (e.g., *Hydrilla*, *Chara*, *Typha angustifolia* and *Nymphaea* spp.), with many stretches bordered by canebrakes. Trees that withstand waterlogging such as *Barringtonia acutangula*, *Terminalia arjuna* and *Pongamia pinnata* occur along its banks or at silted sites. The Pedda Wagu generally dries up during the dry season, except for the small stretch at the end of its course and in a few deeper portions. The Chinna Wagu generally dries up completely during summer.

Nelapattu: Nelapattu Bird Sanctuary is situated about 10 km from the north-western border of Pulicat lake. The Sanctuary encompasses an area of 458.92 ha, of which 82.56 ha constitute the tank area. The tank and its bund have *Barringtonia acutangula* and a few other tree species as nest trees. The Nelapattu Pelicanry is very old, and the birds were reported to be nesting in Nelapattu village initially before shifting to the Nelapattu tanks (Nagulu 1983).

Vedurupattu-Edhirpattu: Vedurupattu-Edhirpattu Heronry, also referred to as either Vedurupattu or Edhirpattu,

is situated 12 km from the Nelapattu Pelicanry. Vedurupattu and Edhirpattu are two adjoining villages along the Kalangi river, where the birds nest on *Azadirachta indica*, *Ficus* sp., *Acacia nilotica* and *Borassus flabellifer*. This heronry is protected by the villagers and Forest Department (Ramakrishna 1990, 1996).

Tada (Bolengalupadu) Heronry: Tada Heronry is situated at the outskirts of Tada (a small town 4 km south of Sullurpet on NH-5), which is witnessing rapid growth since the beginning of this century after declaration of the region as a Special Economic Zone by the Andhra Pradesh Government. The heronry now consists of only one of the original three *Ficus* trees.

Sriharikota heronries: There are three heronries in Sriharikota, the Madugu, Beripeta and Karimanal heronries. The Madugu Heronry is a mixed species heronry situated in the northern part of the Island and has a riparian forest-thicket vegetation with dense canebrakes. Beripeta is in the central region and consists of riparian forest with tall trees predominantly used by the Painted Storks *Mycteria leucocephala*. The Karimanal Heronry, at the southern end of the Island, a mixed species colony, was earlier situated in a lowland area on casuarina saplings, but the birds have shifted to nearby *Ficus* tree after the casuarina dried up (Manakadan and Sivakumar 2004a; Sivakumar and Manakadan 2005).

METHODS

This paper is primarily based on records kept by the first two authors on the waterbirds of the Pulicat lake and some of the adjoining wetlands and heronries. Their observations were made during regular field visits and systematic census conducted over three years (December 2004 to November 2007). Records obtained during two earlier projects in which the first two authors were involved (Manakadan and Kannan 2003; Manakadan and Sivakumar 2004a) and published or unpublished literature or data of other workers were also accessed for the species accounts.

RESULTS AND DISCUSSION

A total of 77 species of waterbirds were recorded in the Pulicat lake area (inclusive of those in the adjoining wetlands and heronries) during the study. Additionally, another seven species, with all except one recorded in the wetlands of Sriharikota Island, were recorded during the earlier two projects in which the first two authors were involved. Of the overall total of 84 species recorded, 23 species were primarily freshwater species and were not recorded in Pulicat lake but in the adjoining wetlands and

heronries, as were some of the other species recorded by earlier workers. Twenty-nine species recorded by earlier workers were not recorded during the study period, many of these being rare one time records or species captured only during bird banding exercises. With one new species, the Black-bellied Tern *Sterna acuticauda*, recorded during this study and taking into consideration the records of other workers, the checklist of waterbirds of the Pulicat lake area comprises 113 species. Given below are the accounts of 113 species of waterbirds reported from Pulicat lake and in the adjoining wetlands and heronries.

Abbreviations used: R = Resident, with or without breeding records. WM = Winter Migrant, species that breeds in the Palaearctic region/Himalaya during spring and that winters in the Indian subcontinent. SM = Seasonal Migrant, an 'Indian species' that occurs seasonally in the Pulicat area. V = Vagrant, a species recorded outside its normal distributional range. VC = Very Common, sightings possible on almost all days in a year/season in suitable habitats. C = Common, sightings of about once a week in a year/season in suitable habitats. O = Occasional, about one sighting fortnight/month in a year/season in suitable habitats. Ra = Rare, fewer than five sightings per year or three sightings a season. VRa = Very Rare, record based on only one or two sighting during this or earlier projects. ? = Status Uncertain.

Little Grebe *Tachybaptus ruficollis* R C

The Little Grebe is common in the freshwater wetlands of the Pulicat lake area. It was largely seen during September to January in the Kudiri and Mallam tanks. Around 20-30 birds were regularly seen in the Kudiri and Nelapattu tanks, with breeding activity recorded. Breeding had also been reported in Nelapattu by Philip *et al.* (1998) and Santharam (unpublished data). In Sriharikota, the species occurs and breeds in the Pedda and Chinna Wagus (Samant and Rao 1996; Manakadan and Sivakumar 2004a).

Spot-billed Pelican *Pelecanus philippensis* R VC

The Spot-billed Pelican is a common species in Pulicat lake and breeds in the Nelapattu Heronry. The breeding population was 200+ pairs during 2001-2003 (Manakadan and Kannan 2003) and was around 500+ pairs during this study. A stray record of breeding (two nests) had been reported from the Vedurupattu-Edhirpattu Heronry (Ramakrishna 1990). Large congregations are mainly seen in Pulicat lake during the onset of breeding in October; otherwise pelicans occur in smaller flocks or singly. The birds also frequent the larger water bodies around Pulicat lake, but avoid those with dense aquatic vegetation. See Manakadan and Kannan (2003) for more details of the Spot-billed Pelican in Pulicat-Nelapattu.

Little Cormorant *Phalacrocorax niger* R VC

The Little Cormorant is a breeding resident and was seen throughout the year in Pulicat and in all the adjoining freshwater water bodies. It breeds in heronries in Nelapattu, Sriharikota (and bred till the 2001-2002 breeding season in Tada). Santharam (unpublished data) recorded 92 nests at Vedurupattu-Edhirpattu in January 1988. An extremely large count of 3,445 birds (including 247 chicks) was recorded in Nelapattu in March 1997 by Philip *et al.* (1998). The number of breeding pairs recorded during our study at Nelapattu ranged from 225 in 2005-2006 to 113 in 2006-2007. Sivakumar and Manakadan (2005) reported c. 300 nests in the Karimanal Heronry in Sriharikota Island.

Indian Shag *Phalacrocorax fuscicollis* R Ra

The Indian Shag is an uncommon species in the Pulicat lake with only a record of 10 individuals obtained near Togaramudi in the northern part of Pulicat lake in February 2006. A few sightings were reported from Kudiri Tank by the Forest Department. Manakadan and Sivakumar (2004a) had one record of three birds in Urugayya Lake (Sriharikota Island) from 2001 to 2004. Though rarely seen in Pulicat Lake and the other wetlands, up to 151 pairs were recorded to nest in Nelapattu during the study period. Earlier records include c. 1,200 birds during the 1987-88 breeding season (Perennou 1990; Perennou and Santharam 1990) and 1,384 birds in January 1991 (Santharam, unpublished data).

Great Cormorant *Phalacrocorax carbo* V VRa

The only record of the Great Cormorant in the Pulicat lake area is by Perennou and Santharam (1990) reporting two non-breeding birds in Nelapattu in January 1989. The species appears to be a vagrant to the area.

Oriental Darter *Anhinga melanogaster* SM? Ra

There are no reports on the occurrence of the Oriental Darter in Pulicat lake, and it has been recorded only in the adjoining wetlands. Two to three birds were regularly seen in Nelapattu during the 2000-2001 breeding season, but the only sighting in Nelapattu after that was of a single bird in January 2007. Manakadan and Sivakumar (2004a) recorded three darters in April 2002 in the Madugu Wagu and solitary birds during December 2002 and May 2004 in the Malliplate (Mavalam) Wagu of Sriharikota Island. A solitary bird was sighted in the Malliplate Wagu during August 2007 (B. Senthil Murugan pers. comm.). Santharam's (unpublished data) records for Nelapattu were two birds each in January 1991 and 1996, and four birds including a juvenile in January 2003.

Lesser Frigatebird *Fregata ariel* V VRa

The only record of the Lesser Frigatebird, a pelagic species, was of a female in Sriharikota Island in July 1991 (Rao and Mohapatra 1993a, 1993b; Samant and Rao 1996). The Lesser Frigatebird has also been reported from Chennai, about 40 km to the south of the Pulicat lake (Santharam 1982).

Little Egret *Egretta garzetta* R VC

The Little Egret is a very common species occurring throughout the year in Pulicat, and the other wetlands and breeding in the heronries in the Pulicat area. Past records include 20+ nests in January 1988 (Perennou and Santharam 1990) and 34 nests in January 1991 (Santharam, unpublished data) in the Vedurupattu-Edhirpattu Heronry, 219 adults and 118 chicks in Nelapattu (Philip *et al.* 1998) and *c.* 150 nests in the Sriharikota heronries during the 2001-2002 breeding season (Sivakumar and Manakadan 2005). Samant and Rao (1996) described it as 'one of the commonest egret species encountered in all water bodies'. The birds were mostly seen in small flocks near drying pools and temporary wetlands, sometimes occurring in large congregations of 1000+ birds where fish get trapped in shallows.

Western Reef-Heron *Egretta gularis* SM? VRa

Only one individual was sighted in the northern part of Pulicat near Pambali during November 2006. Rao (1998) described it as 'uncommon in most areas' and reports of a sighting from the northern areas of Sriharikota Island and 'up to 5 individuals recorded at a time in Pulicat lagoon'. Manakadan and Sivakumar (2004a) did not record the species. Santharam (unpublished data) recorded it in small numbers on a few occasions in Pulicat lake.

Grey Heron *Ardea cinerea* R VC

The Grey Heron is relatively common throughout the year in Pulicat, feeding especially in association with the Painted Stork, Large Egret and Spot-billed Pelican. The highest count of a congregation during this study was of 103 birds in 2007. It has been reported breeding in the Tada and Vedurupattu-Edhirpattu heronries with up to 30+ nests in Tada and 18 nests in Vedurupattu-Edhirpattu (Perennou and Santharam 1990; Ramakrishna 1990; Santharam, unpublished data), but does not usually breed in Nelapattu. A new breeding site is in Sriharikota Island, where Manakadan and Sivakumar (2004a) reported a total of 14 breeding pairs in the three heronries.

Purple Heron *Ardea purpurea* R O

The Purple Heron is a solitary and uncommon species,

seen only in thickly vegetated freshwater wetlands around Pulicat lake. It was occasionally sighted from the wagus of Sriharikota Island (Samant and Rao 1996; Rao 1998; Manakadan and Sivakumar 2004a). The only breeding record in the areas is of a nest at Nelapattu in August 1996 (Santharam, unpublished data).

Great Egret *Egretta alba* R VC

The Great Egret is a common species in Pulicat with high counts of around 300 occasionally, and once of 717 birds. The only known breeding record of the species is of six nests from the Karimanal Heronry in Sriharikota (Manakadan and Sivakumar 2004a; Sivakumar and Manakadan 2005).

Intermediate Egret *Egretta intermedia* R O

The Intermediate Egret was not recorded in Pulicat lake during this study, but a few were occasionally recorded in freshwater tanks. Manakadan and Sivakumar (2004a) also recorded the species only in freshwater habitats in Sriharikota but not in Pulicat lake. Samant and Rao (1996) and Rao (1998) describe its occurrence in Sriharikota Island as a 'rather uncommon in most water bodies but often seen in good numbers towards February-March when individuals shift to the island from Pulicat'. The only breeding records of the species are of a nest in the Karimanal Heronry in Sriharikota (Manakadan and Sivakumar 2004a; Sivakumar and Manakadan 2005) and of *c.* 10 nests in Nelapattu in January 2003 (Santharam, unpublished data).

Eastern Cattle Egret *Bubulcus ibis* R O

The Eastern Cattle Egret is a common species largely recorded in November and December. It is mostly seen in ploughed fields following livestock. It becomes uncommon during summer. The population visiting the Pulicat area each year is probably in the range of 200 to 400 birds. A few birds (10 pairs during the 2005-2006 breeding season and 12 pairs during the 2006-2007 season) were recorded to breed at Nelapattu during this study. Philip *et al.* (1998) had recorded 116 adults and 36 chicks during March 1997.

Indian Pond-Heron *Ardeola grayii* R VC

The Indian Pond-Heron is a common species in Pulicat and the other wetlands, foraging mostly at the edges of water bodies. They shift to wet agricultural fields when Pulicat and the other water bodies dry up. A large congregation of 104 birds was recorded during March 2006 and another of 161 birds during January 2007. There are no records of the species nesting in the Pulicat area.

Striated Heron *Butorides striata* R VRa

Only one bird was sighted during May 2005 and one in December 2007 near Srinivasapuram in the northern part of Pulicat. Rao (1998) obtained two sightings from Sriharikota Island during his 3-year study, and B. Senthil Murugan (pers. comm. in 2007) recorded one in the Beripeta Heronry (Sriharikota) during February 2007. Santharam (unpublished data) had a sighting of a bird in January 1998 in Sriharikota.

Black-crowned Night-Heron *Nycticorax nycticorax* R O

The Black-crowned Night-Heron was not recorded from Pulicat lake, but c. 200 pairs breed in Nelapattu. It also occurs in Sriharikota Island (Rao 1998) and probably breeds there (Manakadan and Sivakumar 2004a; Sivakumar and Manakadan 2005). Santharam (1982) recorded an adult Night Heron killed by a Booted Eagle (*Hieraeetus pennatus*).

Yellow Bittern *Ixobrychus sinensis* R VRa

The Yellow Bittern was not recorded during the study. Rao (1998) and Manakadan and Sivakumar (2004a) had one sighting each from the Pedda Wagu area in Sriharikota Island. Santharam (unpublished data) had three sightings of the species: two birds in February 1990 in Sriharikota, and four birds in Nelapattu and two birds at Kudiri Tank in August 1996.

Chestnut Bittern *Ixobrychus cinnamomeus* R Ra

The Chestnut Bittern was recorded by Manakadan and Sivakumar (2004a), recording solitary birds around the Beripeta Heronry and Urugayya lake in Sriharikota in June and October 2002, respectively. B. Senthil Murugan (pers. comm. in 2007) obtained a number of sightings in dense vegetation near the Malliplate (Mavalam) Wagu culvert in Sriharikota. It probably breeds on the island. Santharam (unpublished data) recorded three birds at Nelapattu (including a juvenile) during August 1996.

Black Bittern *Dupetor flavicollis* R O

The Black Bittern was not recorded during the study. (Rao 1998) obtained a few records in Sriharikota Island. Manakadan and Sivakumar (2004a) obtained two records each along the Buckingham Canal and Urugayya lake in Sriharikota Island. B. Senthil Murugan (pers. comm. in 2007) obtained a sighting in dense vegetation near the Malliplate (Mavalam) Wagu culvert in Sriharikota Island. Santharam (unpublished data) obtained two sightings of single birds from Sriharikota Island (during March 1990 in Beripeta and April 1990 in Pedda Wagu).

Eurasian Bittern *Botaurus stellaris* WM VRa

The only record of the Eurasian Bittern is by Rao (1998),

who sighted a bird from the marshy area of Pedda Wagu near Ravanappa Chatram in Sriharikota during March 1991.

Painted Stork *Mycteria leucocephala* R VC

The Painted Stork is a very common resident species in Pulicat and in the other larger wetlands. The highest count obtained during this study was 645 birds off Beripeta during August 2006. The species bred in some years in the Vedurupattu-Edirpattu Heronry (c. 15 pairs) during this study, but this heronry had earlier supported a larger number of nests: 200 nests (Ramakrishna 1996), 273 nests (Philip *et al.* 1998) and 135 nests (Santharam 1998). It appears that the birds have almost totally shifted to the heronries in Sriharikota since the beginning of this century, with regular breeding in the Beripeta heronry supporting more than 200 pairs.

Asian Openbill *Anastomus oscitans* R C

The Asian Openbill is a breeding migrant arriving in September and departing by April. Being a freshwater species, it is rarely seen in Pulicat lake, and the few records from Pulicat lake were after rains. Rao (1998) and Manakadan and Sivakumar (2004a) occasionally encountered the species in the freshwater bodies of Sriharikota Island. It breeds in Nelapattu, numbering 300 to 350 pairs.

Woolly-necked Stork *Ciconia episcopus* V VRa

The only record of the Woolly-necked Stork during this study was a bird sighted in February 2001 at the outskirts of Venadu village, an island in Pulicat. Santharam (unpublished data) recorded a bird flying over Nelapattu during December 1987.

White Stork *Ciconia ciconia* WM VRa

Rao and Mohapatra (1993a) list the White Stork, but without providing details. We recorded a pair in a freshwater wetland north of Tada town amidst a flock of foraging Asian Open-bill Stork in January 2005.

Glossy Ibis *Plegadis falcinellus* SM Ra

About 200-250 Glossy Ibis were recorded annually during November and December in crop fields adjacent to Pulicat and in the Kudiri Tank. A flock of 19 birds was seen in the Penubakkam Badava in Sriharikota Island in February 2002 (Manakadan and Sivakumar 2004a). Santharam (unpublished data) did not record the species in Pulicat before 1988, but recorded it subsequently on four occasions in numbers ranging from 10 to 144 birds.

Black-headed Ibis *Threskiornis melanocephalus* R O

The Black-headed Ibis breeds in Nelapattu and was

occasionally recorded in the Pulicat area, freshwater wetlands and also inundated crop fields. Rao (1998) and Manakadan and Sivakumar (2004a) reported a few sightings from Sriharikota Island. The maximum number of breeding pairs observed at Nelapattu during this study was 198 in 2006. Santharam (unpublished data) feels that the species is getting to be commoner in Nelapattu in recent years: less than 100 birds used to be seen in the early 1980s, and since 1997, there are sightings of over 200 individuals, plus a record of 250 birds in the Kudiri tanks in February 1990.

Indian Black Ibis *Pseudibis papillosa* V VRa

The occurrence of the Indian Black Ibis in Pulicat lake is cited by Rao and Mohapatra (1993a) without providing details. B. Senthil Murugan and J. Patrick David (pers. comm. in 2007) sighted a flock of 40 birds in a paddy field near Sullurpet in February 2007.

Eurasian Spoonbill *Platalea leucorodia* R/SM? Ra

The Eurasian Spoonbill was occasionally recorded in Pulicat and other freshwater wetlands in small numbers, with the largest flocks of 170 to 200 birds recorded during April and May 2006. Rao (1998) described the species as rare on Sriharikota Island, and Manakadan and Sivakumar (2004a) recorded the species once from Urugayya and Pulicat lakes. The species was also seen in Nelapattu in small numbers of 10 to 15 birds during the breeding season. There are no recent records of the species breeding in the Pulicat area, but it had been recorded nesting in small numbers at Nelapattu in the early 1980s (Santharam, unpublished data) and Ramakrishna (1990) had reported three or four nests in Vedurupattu-Edhirpattu.

Greater Flamingo *Phoenicopterus ruber* SM VC

The Greater Flamingo is a seasonal migrant seen largely in winter, but some birds can be found almost throughout the year. The numbers counted during this study were c. 8,000 in 2005, 15,000 in 2006 and 13,000 in 2007. Krishnan (1990) reports 3,000+ flamingos in Pulicat lake in 1983, and Rao and Mohapatra (1993a) cite figures ranging from 2,000+ to 5,000+ from 1988 to 1992 for both the flamingo species together. Santharam's (unpublished data) counts include 4,000 birds (including juveniles) in July 1996, 9,000 birds in January 1998, and 8,000 birds in December 2000.

Lesser Flamingo *Phoeniconaias minor* SM Ra

The Lesser Flamingo was infrequently recorded in Pulicat. The highest count was of c. 3,000 birds in May 2007. Manakadan and Sivakumar (2004a) sighted it occasionally during fortnightly censuses in the southern part of the lagoon,

with a maximum of c. 1,000 birds recorded during 2003-2004. Birds were not recorded during the 2002-2003 season, a low rainfall year. Rao (1998) found the species to be rare in Pulicat lake. Santharam (unpublished data) recorded 5,300 birds in January 1988, 300 birds in August 1996 and 100 birds in December 1997.

Lesser Whistling-Duck *Dendrocygna javanica* R VRa

The Lesser Whistling-Duck was not recorded during this study, but the species breeds in Sriharikota Island, where flocks of 10 to 30 birds were recorded on a few occasions (Manakadan and Sivakumar 2004a). They sighted two pairs, one with 14 ducklings and the other with a duckling in the Chinna Wagu in April 2002. The species was not recorded by Rao (1998) in Sriharikota though it was reported by the earlier BNHS survey (BNHS 1977). Senthil Murugan (pers. comm.) sighted 23 birds in Kudiri Tank in 2007. Santharam (unpublished data) recorded 20 birds at Nelapattu in October 1981.

Bar-headed Goose *Anser indicus* WM Ra

The Bar-headed Goose is a rare winter migrant to the Pulicat lake area. During this study, the species was recorded only in December 2006 and January 2007, with flocks of up to 150 birds mostly sighted in abandoned crop fields near Moolah village, adjacent to Pulicat lake. Rao (1998) and Manakadan and Sivakumar (2004a) had only one sighting each of about a dozen birds flying over Sriharikota. Santharam's (unpublished data) counts include 200 birds from the Pulincherry area in January 1998 and 150 birds in Venadu Island in December 2000.

Ruddy Shelduck *Tadorna ferruginea* WM VRa

Krishnan (1990) cites the occurrence of the Ruddy Shelduck in the Pulicat area without providing details. The only records of the Ruddy Shelduck after that are of six birds sighted by us in the Kudiri tank in January 2001 and a record of three birds in Nelapattu during the 2001 Asian Waterfowl Count (AWC). Santharam (unpublished data) recorded it thrice (2-5 birds) along the Sriharikota-Sullurpet road from 1981 to 2000.

Comb Duck *Sarkidiornis melanotos* Locally Extinct?

The Comb Duck was recorded only during the first BNHS survey (BNHS 1977), but details of the sightings were not provided. Perennou (1990) had expressed alarm at the low counts obtained during the AWC in India, commenting that it is almost absent in southern India and extinct in Sri Lanka. It appears to have become extinct in the Pulicat area.

Cotton Teal *Nettapus coromandelianus* R VRa

The Cotton Teal was not recorded during this study. The first BNHS survey recorded 'small flocks' in the Pedda and Chinna Wagus of Sriharikota (BNHS 1977). Manakadan and Sivakumar (2004a) sighted two birds in August 2002 at the Mudugu Gunta. Rao (1998) had three sightings during his 3-year study. Santharam (unpublished data) recorded 100+ birds at a freshwater body near Tada in October 1981.

Gadwall *Anas strepera* WM Ra

The Gadwall was reported in small numbers in freshwater bodies of Sriharikota Island (Rao 1998; Manakadan and Sivakumar 2004a). The species is listed by Krishnan (1990), but details of the sightings are not provided. Santharam (unpublished data) sighted 20+ birds in Sriharikota Island in January 1990.

Eurasian Wigeon *Anas penelope* WM Ra

The Eurasian Wigeon is a relatively uncommon wintering duck frequenting only the freshwater wetlands. About 50-60 birds were occasionally recorded in Kudiri Tank, with high counts of 322 birds recorded during March 2006. Rao (1998) and Manakadan and Sivakumar (2004a) occasionally recorded the species in small numbers in the freshwater streams in Sriharikota. Santharam (unpublished data) found the species to be relatively common in the Pulicat lake area, reporting counts of more than 2,000 birds in December 1997 and January 1988. Additionally, he feels that extremely large flocks of unidentified ducks seen on three occasions from a considerable distance numbering around 37,000 (January 1998), 28,500 (January 1991) and 46,540 (January 1998), primarily consisted of this species and the Northern Pintail considering the size.

Indian Spot-billed Duck *Anas poecilorhyncha* R VC

The Indian Spot-billed Duck was largely recorded in freshwater wetlands around Pulicat lake and to a much lesser extent, in areas of the Pulicat lake that had submerged vegetation. About 500 birds were seen in the Kudiri Tank during April 2007. The species is common in Sriharikota Island, with flocks of around 250 birds recorded each summer in Urugayya lake (Rao 1998; Manakadan and Sivakumar 2004a). Breeding records were obtained from Sriharikota Island and the Attakanitippa and Kudiri tanks.

Northern Shoveller *Anas clypeata* WM C

The Northern Shoveller was recorded in Kudiri Tank and to a lesser extent Pulicat lake. The largest count recorded was c. 1,700 birds near the Venadu mudflats in January 2007.

Rao (1998) described the species as 'a very common migratory duck recorded at all water bodies in the island'.

Northern Pintail *Anas acuta* WM VC

The Northern Pintail is the most common and abundant migratory duck in Pulicat lake and the adjoining wetlands. The largest count during this study was c. 3,300 birds. Samant and Rao (1996) had recorded a flock of nearly 4,000 birds. Around 500 birds were recorded by Manakadan and Sivakumar (2004a), and the 1991 AWC recorded c. 12,500 birds (Rao and Mohapatra 1993a). Santharam's (unpublished data) counts ranged from 2,000+ (December 1997) to 4,300 birds (January 1998), but see also Eurasian Wigeon.

Garganey *Anas querquedula* WM C

The Garganey was recorded in freshwater tanks during winter but was rarely seen in Pulicat lake. The highest counts during the AWC were 436 and 320 birds in 2003 for Pulicat and Nelapattu respectively. Rao (1998) had recorded up to 175 birds in water bodies of Sriharikota Island. Santharam (unpublished data) recorded 2,000+ birds in Pulicat lake along the Sullurpet-Sriharikota road in December 1997.

Common Teal *Anas crecca* WM C

The Common Teal was largely recorded in the freshwater wetlands, with a high count of c. 4,000 birds during the study. Rao (1998) had a count of more than 750 birds in Sriharikota in January 1991.

Common Pochard *Aythya ferina* WM VRa

The occurrence of the Common Pochard in Pulicat lake area is cited by Krishnan (1990) and Rao and Mohapatra (1993a) without providing details. Philip *et al.* (1998) obtained a count of 44 birds in Nelapattu. Santharam (unpublished data) recorded two birds at Nelapattu in March 1998 and found the species to be common in freshwater bodies in Nellore district. We had no sightings of the species since December 2000 while working under different projects.

Red-crested Pochard *Rhodonessa rufina* WM VRa

The Red-crested Pochard was recorded in small parties (<100 birds) only during January and February of 2006, and 2007 in the Kudiri Tank. The species had not been reported by earlier workers except Santharam (unpublished data), who recorded 80 birds in January 1988 and 500+ birds in January 2005 in Kudiri Tank.

Tufted Pochard *Aythya fuligula* WM VRa

Philip *et al.* (1998) obtained a count of 112 birds in Nelapattu. Santharam (unpublished data) recorded 140 birds

in the Tada area of Pulicat Lake in January 1998. The 2003 AWC reports a count of 230 birds. We have had no sightings of the species from December 2000 while working under various projects but found it to be common in the wetlands of Gudur, c. 50 km north of Pulicat.

Brahminy Kite *Haliastur indus* R C

Rao (1998) and Manakadan and Sivakumar (2004a) frequently recorded the Brahminy Kite in almost all the areas of the Sriharikota Island and occasionally in Pulicat. During this study, the species was recorded only in the southern part of the Pulicat near fishing hamlets. Santharam (unpublished data) used to record the species nesting regularly at Nelapattu and feels it is on the decline in the Pulicat area.

White-bellied Sea-Eagle *Haliaeetus leucogaster* R C

The White-bellied Sea-Eagle is fairly common in Sriharikota Island, with half a dozen nests reported (Rao 1998; Manakadan and Sivakumar 2004a). The species was frequently seen in and around Pulicat and Kudiri Tank during this study.

Western Marsh-Harrier *Circus aeruginosus* WM O

Rao (1998) reported the Western Marsh-Harrier to be common in most of the wetland areas in Sriharikota. The species was not recorded by Manakadan and Sivakumar (2004a) in Sriharikota, but they had a sighting of two birds in the northern part of Kudiri Tank. We recorded the species regularly in the freshwater wetlands of Kudiri, Mallam and Nelapattu.

Osprey *Pandion haliaetus* WM Ra

Rao (1998) recorded the Osprey occasionally in some of the large waterbodies in Sriharikota and stated it to be fairly common in Pulicat lagoon during winter. Manakadan and Sivakumar (2004a) recorded only a pair in Pulicat Lagoon off the Beripeta area of Sriharikota Island. Only a single bird was sometimes recorded from the Annamalaicherry area of Pulicat during this study. Santharam (unpublished data) had seen one or two birds along the Sriharikota road in 1990, but did not record the species subsequently.

Slaty-breasted Rail *Rallus striatus* R? VRa

The only earlier records of the Slaty-breasted Rail in the Pulicat area were made during the first BNHS survey in Sriharikota Island (BNHS 1977) and by Rao (1998) from 'marshes near Sullurpet', probably referring to the Kudiri Tank. Recently, B. Senthil Murugan and J. Patrick David (pers. comm. in 2007) obtained a road kill in Sriharikota.

Ruddy-breasted Crake *Porzana fusca* R/SM? VRa

The only record of the Ruddy Crake is by Santharam (unpublished data), who sighted a bird in January 1990 on the Sriharikota Island.

European Water Rail *Rallus aquaticus* V VRa

Manakadan and Sivakumar (2004a, 2004b) sighted a bird towards the end of May 2003 along the Pedda Wagu in Sriharikota Island. This sighting is the southernmost record of the species in India, which till then had not been reported south of Mumbai (Punjabi 1997).

White-breasted Waterhen *Amaurornis phoenicurus* R VC

The White-breasted Waterhen is a common resident species and was frequently recorded in and around freshwater habitats. Rao (1998) described it as common and seen in most well watered areas of Sriharikota Island.

Purple Swamphen *Porphyrio porphyrio* R/SM? Ra

The Purple Swamphen was recorded in freshwater tanks and largely in Kudiri Tank with about 10-15 birds recorded yearly from January to March. Rao and Mohapatra (1993a) list the species without providing details. The species was ringed in Kudiri lake in February 1989 (Balachandran 1998).

Common Moorhen *Gallinula chloropus* R VC

The Common Moorhen was recorded in Kudiri and the other freshwater tanks. The highest count of 10 birds was from the Kudiri Tank in January 2006. The species is common and breeds in Sriharikota (Rao 1998; Manakadan and Sivakumar 2004a), Nelapattu (Philip *et al.* 1998) and Vedurupattu-Edhirpattu (Santharam 1998).

Eurasian Coot *Fulica atra* R/SM? Ra

The Eurasian Coot was recorded only in freshwater tanks, and the highest count was of c. 250 birds in Kudiri Tank in February 2006. Rao (1998) recorded it occasionally from some of the freshwater bodies in Sriharikota Island and recorded c. 400 birds in May 1990 in Kudiri Tank. Philip *et al.* (1998) recorded 42 adults and 36 chicks in Nelapattu, and Santharam (1998) recorded breeding in the Vedurupattu-Edhirpattu area.

Pheasant-tailed Jacana *Hydrophasianus chirurgus* SM? O

The Pheasant-tailed Jacana was recorded in vegetated freshwater tanks just after the monsoon and till March. The highest count was 15 birds in Kudiri during March 2006. Rao and Mohapatra (1993a) sighted the species mostly in shallow freshwater bodies in Sriharikota Island with a count of 11 birds in February 1992. Manakadan and Sivakumar

(2004a) described the species as an occasional seasonal migrant in small numbers to Sriharikota. Santharam (unpublished data) sighted four birds in non-breeding plumage at Nelapattu in March 1998.

Greater Painted-Snipe *Rostratula benghalensis* WM O

The Greater Painted-Snipe was not recorded during the study, but B. Senthil Murugan and J. Patrick David (pers. comm. in 2007) obtained a sighting of a solitary bird in Kudiri Tank during the winter of 2007. The species was sighted on a few occasions around water bodies in Sriharikota in winter (Rao 1998; Manakadan and Sivakumar 2004a; Santharam, unpublished data).

Pacific Golden-Plover *Pluvialis fulva* WM C

The Pacific Golden-Plover is a regular winter migrant to Pulicat. The high counts include 239 birds in April 2005 in the Venadu mudflats and 341 birds in December 2006 at the grassy edges of Kudiri Tank. Rao (1998) cites it as very common in the coastal sand dunes in the north-eastern part of Sriharikota, mentioning flocks of 10 to 15 birds. Santharam (unpublished data) recorded 1,500 birds in January 1998.

Grey Plover *Pluvialis squatarola* WM O

The Grey Plover was rarely recorded in Pulicat lake with a few sightings of solitary birds or a party of a few birds from September till March. Rao (1998) described it as a widespread and common winter visitor to Sriharikota Island preferring coastal mudflats, reporting 12 birds in partial breeding plumage in May 1991. Manakadan and Sivakumar (2004a) recorded the species occasionally in the brackish Urugayya lake (Sriharikota Island) and Pulicat.

Common Ringed Plover *Charadrius hiaticula* WM VRa

The Common Ringed Plover was not recorded during the study and by Manakadan and Sivakumar (2004a). Rao and Mohapatra (1993a) obtained several sightings from Pulicat lake during the 1990-1991 season, stating the species was rare but adding that these was a likelihood of it being mistaken for the Little Ringed Plover. The species has been reported from the Adyar Estuary in Chennai, c. 40 km from Pulicat (Santharam 1989).

Little Ringed Plover *Charadrius dubius* R/SM VC

The Little Ringed Plover is a breeding resident, occurring in Pulicat lake and other open wetlands in the area. It was recorded almost throughout the year during this study. Tribals say that the species breeds in the dry bed of Katankayya lake (Sriharikota Island) during summer (Manakadan and Sivakumar 2004a). The highest count of a congregation was of c. 800 birds in 2007.

Kentish Plover *Charadrius alexandrinus* R/SM O

The Kentish Plover was recorded in small numbers or in pairs almost throughout the year in Pulicat lake and in other suitable freshwater and brackish water habitats. The highest count was c. 400 birds in Pulicat. It was suspected to breed in Pulicat lake (Samant and Rao 1996; Rao 1998; Manakadan and Sivakumar 2004a), and confirmed breeding records were obtained during this study. Breeding records of this predominantly winter migrant have been reported from the Great Vedaranyam Swamp, Tamil Nadu (Sugathan 1982; Manakadan 1992; Natarajan 1992).

Lesser Sand Plover *Charadrius mongolus* WM O/Ra

Most of the sightings of the Lesser Sand Plover were from the southern areas of Pulicat in the Annamalaichery tidal flats, with counts of up to 1,000 birds. It was not common in the central and northern parts of Pulicat. Rao (1998) found it to be not as common as the Kentish Plover, recording only small flocks of 20-30 birds. Manakadan and Sivakumar (2004a) had only one sighting of nine birds in Urugayya lake (Sriharikota) in October 2002.

Greater Sand Plover *Charadrius leschenaultii* WM VRa

The Greater Sand Plover was not sighted during the study. Mohapatra and Rao (1994) reported of a record from Pulicat lake. Rao (1998) reported a possible sighting in March 1991 from the Chandrasikuppam area of Sriharikota Island, and Manakadan and Sivakumar (2004a) recorded 14 birds in August 2002 from the same area.

Black-fronted Plover *Charadrius melanops* V VRa

The only record of the species in Pulicat Lake (and in the Indian subcontinent) is provided by T.C. Jerdon from June 1839/1840 (Ali and Ripley 1987), but the identity of the species requires further substantiation (Rasmussen and Anderton 2005).

Red-wattled Lapwing *Vanellus indicus* R C

The Red-wattled Lapwing is a common species in freshwater habitats, mostly occurring in pairs and breeding during April and May.

Pintail Snipe *Gallinago stenura* WM O

The only records of the Pintail Snipe are by Rao (1998), consisting of a few sight records and banding of a bird in Sriharikota.

Common Snipe *Gallinago gallinago* WM O

We recorded the Common Snipe occasionally in grassy areas under *Prosopis* bushes along the Pernadu road and in

agricultural fields adjacent to freshwater wetlands. Sightings were more during November and December just after the monsoon. The species is listed by Rao and Mohapatra (1993a) without providing details.

Jack Snipe *Lymnocyptes minimus* WM VRa

The occurrence of the Jack Snipe in the Pulicat lake area is reported by Rao and Mohapatra (1993a) without providing details.

Black-tailed Godwit *Limosa limosa* WM C

The Black-tailed Godwit was a regular winter migrant to Pulicat lake and Kudiri Tank. Large flocks of c. 1,000-2,000 birds were seen during October and January each year near the Venadu mudflats, Kudiri Tank and adjoining paddy fields. Rao (1998) described it as 'a regular but uncommon winter visitor'.

Whimbrel *Numenius phaeopus* WM Ra

The Whimbrel was occasionally seen singly or in twos or threes near Tada and in grasslands bordering the southern part of Pulicat lake. Rao (1998) and Manakadan and Sivakumar (2004a) recorded it occasionally in Sriharikota Island.

Eurasian Curlew *Numenius arquata* WM O

The Eurasian Curlew was occasionally sighted in Pulicat lake and in the Kudiri Tank usually occurring in small parties of twos and threes. An extremely high count of 154 birds was sighted in the Annamalaicherry mudflats during January 2007. Manakadan and Sivakumar (2004a) recorded it occasionally during winter in suitable habitats in Sriharikota Island. High counts by Santharam (unpublished data) are 50+ birds in Kudiri Tank in February 1990 and 70+ birds in Pulicat lake in January 2005.

Spotted Redshank *Tringa erythropus* WM Ra

The Spotted Redshank was only recorded during the second BNHS project (Rao 1998) consisting of ringing and sight records of single birds in December 1989 and April 1990. Manakadan and Sivakumar (2004a) did not record it during the winter of 2001-2002, but recorded up to 200 birds regularly during the 2002-2003 season in Pulicat lake. Only a few birds were recorded during the following winter. During April and May 2005, we recorded c. 60 birds in the Kudiri Tank and the Moolah Cheruvu area of Pulicat. Santharam (unpublished data) recorded the species on two occasions: one bird in April 1990 and 12 birds in January 2005.

Common Redshank *Tringa totanus* WM VC

The Common Redshank is one of the commonest

sandpipers in Pulicat lake, usually occurring in small flocks. However, large congregations of almost 1,000 birds were recorded sometimes in the Annamalicherry mudflats. The species was also recorded in the Kudiri and Nelapattu tanks. It was also regularly recorded by earlier workers (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a).

Marsh Sandpiper *Tringa stagnatilis* WM C

The Marsh Sandpiper was recorded occasionally (usually after showers) in compact flocks of a few hundred birds, and the highest count was c. 1,600 birds recorded during January 2007 in Pulicat. The species was also recorded in Kudiri and Nelapattu. It was also regularly recorded by earlier workers (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a).

Common Greenshank *Tringa nebularia* WM VC

The Common Greenshank is a common winter migrant to Pulicat, usually occurring in ones or twos. Some birds over-summer in Pulicat. Earlier studies too found the species to be a common but not an abundant wintering migrant (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a). The maximum count obtained during this study was 68 birds in April 2006.

Green Sandpiper *Tringa ochropus* WM Ra/VRa

The Green Sandpiper is a rare winter migrant. The only record during the study was outside the study area – in a drying freshwater tank near Gumudipoondi in June 2006. Earlier studies too found the species to be uncommon (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a). Santharam (unpublished data) recorded two birds in October 1981 in Nelapattu.

Wood Sandpiper *Tringa glareola* WM C

The Wood Sandpiper was rare in Pulicat but was a common species in freshwater wetlands, occurring in small parties. It was also seen in ploughed water-logged sites adjacent to Pulicat lake. Earlier studies too found the species to be uncommon in Pulicat (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a).

Terek Sandpiper *Xenus cinereus* WM VRa

The Terek Sandpiper was sighted only once by us in April 2000 along the Sullurpet-Sriharikota road during an earlier project. The only other record of the species in Pulicat lake was a banding record in April 1991 (Rao 1998).

Common Sandpiper *Actitis hypoleucos* WM VC

The Common Sandpiper was common in Pulicat lake

and the adjacent water bodies, occurring at the edges solitarily. It was also regularly recorded in winter by earlier workers (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a).

Ruddy Turnstone *Arenaria interpres* WM VRa

The Ruddy Turnstone is a rare winter migrant. Two birds were recorded during May 2005 in the Annamalacherry mudflats. Manakadan and Sivakumar (2004a) sighted a bird in Urugayya lake (Sriharikota) in October 2002. It could be more common along the coast as it is primarily a dweller of sandy or rocky shores (Ali and Ripley 1987).

Great Knot *Calidris tenuirostris* WM VRa

The record of the Great Knot is based on the banding of six birds from 1990 to 1992 in Sriharikota Island (Mohapatra and Rao 1992; Rao and Mohapatra 1994; Rao 1998).

Red Knot *Calidris canutus* WM VRa

The record of the Red Knot is based only on banding records from 1990 to 1992 in Sriharikota Island (Mohapatra and Rao 1993; Rao and Mohapatra 1994; Rao 1998).

Little Stint *Calidris minuta* WM VC

The Little Stint is the most abundant wader in Pulicat lake; numbering around 20,000+ birds each year. Large flocks were usually recorded in January or February as the northern areas of Pulicat lake dry up and the birds get concentrated along the Sullurpet-Sriharikota stretch of Pulicat, moving southwards towards the lagoon edges as this stretch also gradually dries up. Santharam (unpublished data) recorded huge flocks of 30,000 birds in February 1990 and 16,000 birds in January 1991 probably of this species.

Long-toed Stint *Calidris subminuta* WM VRa

The only record of the Long-toed Stint is from Santharam (unpublished data), who sighted a bird in Kudiri Tank in December 1997.

Temminck's Stint *Calidris temminckii* WM O

Temminck's Stint was uncommon in Pulicat lake during this study, with relatively more sightings from Kudiri Tank and the Sunnambukulam area of Pulicat. Sightings were more common during 2000-2003 during an earlier BNHS project, when a few hundred birds were sometimes recorded in Kudiri Tank.

Curlew Sandpiper *Calidris ferruginea* WM Ra

The Curlew Sandpiper was rarely recorded during the study. The largest congregation recorded was about 200 birds

in the Annamalaicherry tidal flats in May 2007. The species was not recorded during the first BNHS project (BNHS 1977), and Manakadan and Sivakumar (2004a) obtained only two sightings of solitary birds in Pulicat during August and September 2002. However, Rao (1998) reported it to be fairly common in Pulicat between September and mid March and recorded a bird with a Polish ring that was banded in the Arctic Circle region (Rao and Mohapatra 1993a).

Dunlin *Calidris alpina* WM VRa

Rao and Mohapatra (1993a) list the Dunlin without providing details.

Ruff *Philomachus pugnax* WM C

The Ruff is one of the most common waders of Pulicat. It was also regularly sighted in Kudiri Tank. Rao (1998) reported it to be uncommon in Sriharikota, but we recorded flocks frequently in Pulicat lake, with the highest count c. 1,900 birds in January 2007.

Black-winged Stilt *Himantopus himantopus* WM C

The Black-winged Stilt was a common and regular winter migrant occurring in flocks of a few hundred birds in Pulicat and other wetlands. Around 500 birds were sighted in November 2007 in Kudiri Tank. Santharam (unpublished data) counted 800 birds in January 1998.

Pied Avocet *Recurvirostra avosetta* WM VRa

The Pied Avocet was rarely recorded during the study. In June 2006, a flock of c. 15,000 birds was recorded in Pulicat lake. Rao (1998) recorded a flock of c. 500 birds during the 1989-1990 winter season. Manakadan and Sivakumar (2004a) had only one sighting of a small flock in Pulicat lake during their 3-year study. Santharam (unpublished data) recorded the species on five occasions in Pulicat lake, with flocks ranging from 200 to 845 birds.

Red-necked Phalarope *Phalaropus lobatus* WM VRa

The Red-necked Phalarope was recorded only twice during the study in the Sullurpet-Sriharikota mudflats in September 2005 and 2006. The other reports of the species were of a bird in Urugayya lake of Sriharikota in October 2002 Manakadan and Sivakumar (2004a) and banding of six birds in September 1990 (Rao and Mohapatra 1994).

Small Pratincole *Glareola lactea* SM? Ra

The only record of the Small Pratincole from the Pulicat area is of three birds sighted at Vedurupattu-Ethirpattu in January 1991 by Santharam (unpublished data).

Oriental Pratincole *Glareola maldivarum* SM? Ra

Past records of the Oriental Pratincole include banding records by Rao and Mohapatra (1992) from Kudiri Tank, and sightings (Santharam, unpublished data) of birds in Nelapattu: two birds in August 1996 and one bird in August 1997. We recorded the species on a few occasions at the margins of Kudiri Tank: the records include 128 birds in August 2005 and 28 birds in June 2007.

Heuglin's Gull *Larus heuglini* WM VRa

The Heuglin's Gull (earlier treated as the Lesser Blackbacked Gull *Larus fuscus*) was only recorded during the first BNHS survey of Sriharikota Island (BNHS 1977).

Great Black-headed Gull *Larus ichthyaetus* WM VRa

The Great Black-headed Gull was recorded yearly from January to March in Pulicat lake, but mostly from the northern and southern parts. The maximum count was 114 birds, recorded during March 2006. Rao (1998) and Manakadan and Sivakumar (2004a) recorded the species in small numbers in the Kudiri Tank. Santharam (unpublished data) sighted the species twice, with counts of 20+ (January 2005) and 30+ birds (January 2003)

Brown-headed Gull *Larus brunnicephalus* WM C

The Brown-headed Gull is the most common gull wintering in Pulicat lake. The highest count was of 669 birds during the study. Rao (1998) reported flocks of more than 150 birds and Santharam (unpublished data) includes a count of 550 birds.

Common Black-headed Gull *Larus ridibundus* WM?

The Common Black-headed Gull was described as very common during winter in Pulicat (BNHS 1977; Rao 1998). However, it was not recorded from 2002 to 2004 by Manakadan and Sivakumar (2004a), during this study, or by Santharam during his visits spread over 27 years. We suspect that these records were actually of juvenile Brown-headed Gulls (*see* Discussion).

Gull-billed Tern *Gelochelidon nilotica* WM VC

The Gull-billed Tern is a common winter migrant to Pulicat, foraging mostly solitarily or in twos or threes. A resting flock of *c.* 250 birds was seen near the Venadu mudflats in January 2007.

Caspian Tern *Sterna caspia* WM C

The Caspian Tern is a common tern in the lagoon areas of Pulicat and was recorded almost throughout the year. It was not recorded in freshwater wetlands, except for resting

birds in Koridi Tank. About 300 resting birds were seen near the Venadu mudflats in December 2006.

Common Tern *Sterna hirundo* WM VRa

The Common Tern, largely a coastal species (Ali and Ripley 1987), was reported to be less common than other terns during the 1989-1990 season in Pulicat and there are records of the banding of seven birds (Rao and Mohapatra 1993a, 1994; Mohapatra and Rao 1994). The species was not recorded during this study and by Manakadan and Sivakumar (2004a).

Little Tern *Sterna albifrons* R/SM? Ra

The Little Tern was recorded only in freshwater tanks during winter, mostly in Kudiri Tank. The maximum number counted was 100-150 resting birds in January 2005. Samant and Rao (1996), Rao (1998), and Manakadan and Sivakumar (2004a) recorded small flocks of 15-20 birds occasionally in Pulicat lake.

Black-bellied Tern *Sterna acuticauda* V VRa

We obtained only two records of the Black-bellied Tern in the Pulicat lake area with records of single birds near Annamalaicherry in December 2006 and July 2007. The species has not been reported by earlier workers.

Whiskered Tern *Chlidonias hybridus* WM VC

The Whiskered Tern is the most common tern in Pulicat lake and in the freshwater wetlands. A flock of *c.* 300 resting birds was recorded in December 2006 in the northern part of the Pulicat. Rao (1998) and Manakadan and Sivakumar (2004a) found it to be common and widespread, recording birds also during the non-migratory season. Santharam (unpublished data) recorded a flock of 1,490 birds flying down the river at Vedurupattu-Ethirpattu (going to roost?) in February 1998.

White-winged Tern *Chlidonias leucopterus* WM VRa

The only record of the White-winged Tern is by Santharam (unpublished data), who sighted a bird in Pulicat lake in August 1996.

Black Tern *Chlidonias niger* WM VRa

The only earlier record of the Black Tern in Pulicat was based on a bird banded in Sriharikota in October 1990, the record being the first for the species in Andhra Pradesh (Rao and Mohapatra 1993c, 1994). A possible sighting of a single bird was obtained during this study in Kudiri Tank in January 2001.

Brown Fish-Owl *Ketupa zeylonensis* R Ra

The only records of the Brown Fish-Owl in Pulicat area are by Manakadan and Sivakumar (2004a), who sighted birds at two sites in Sriharikota.

Common Kingfisher *Alcedo atthis* R O

Sightings of the Common Kingfisher were rare at Pulicat lake. It was more frequently sighted around freshwater wetlands. The species is common in Sriharikota (Rao 1998; Manakadan and Sivakumar 2004a).

White-throated Kingfisher *Halcyon smyrnensis* R C

The White-throated Kingfisher is a common species in the area and was recorded in a variety of habitats even away from water sources.

Black-capped Kingfisher *Halcyon pileata* R/SM? Ra

The Black-capped Kingfisher was not recorded in Pulicat lake during the study. Manakadan and Sivakumar (2004a) recorded the species along the Buckingham Canal on two occasions and a bird at the brackish water Urugayya lake on Sriharikota in January 2002. Rao (1998) termed it as 'a winter migrant to the island affecting mangrove habitat'.

Lesser-Pied Kingfisher *Ceryle rudis* R O

The Lesser-Pied Kingfisher was occasionally recorded, throughout the year in Pulicat lake and most of the other wetlands, especially around jetties and canals. A nest was seen near Tada. The species was also recorded by earlier workers (BNHS 1977; Rao 1998; Manakadan and Sivakumar 2004a).

Other than the above discussed species, three species of wetland dependent wagtails Yellow Wagtail *Motacilla flava*, Grey Wagtail *Motacilla citreola* and White-browed Wagtail *Motacilla maderaspatensis* were recorded in the Pulicat lake area, mostly occurring at the margins of freshwater waterbodies, but details of these sightings were not maintained as for other waterbird species. Of these, the Yellow Wagtail and the Grey Wagtail are winter migrants; and the White-browed Wagtail is a resident species. The Yellow-wattled Lapwing *Vanellus malabaricus* and the Indian Stone-Curlew *Burhinus oedipnemos* also occur in the area, but we have not included these species – though generally listed in waterfowl count exercises – as these rarely occur around wetlands (Ali and Ripley 1987; Rasmussen and Anderton 2005).

DISCUSSION**Waterbirds of Pulicat Lake**

Pulicat primarily serves as the foraging ground for

brackish water-preferring bird species comprising residents, seasonal migrants and winter migrants from the Palaearctic region. Within Pulicat, an important foraging ground for waterbirds is the shallow region in the central part of the Lake between Sriharikota and Kudiri, which is the area mostly visited by birders due to easy accessibility (Fig. 1). This area is primarily important during November to January/early February after which it gets flooded during the North-east monsoon rains, and especially during the drying stages when it attracts large numbers of piscivorous birds (especially around the many culverts along the Sullurpet-Sriharikota road) and wader species, including flamingos. Another important site is the Moolah Kuppam area on the western edge of Pernadu Island, especially after the Kudiri-Sriharikota stretch dries up. This is a site where the Greater Flamingo may be seen almost throughout the year as borne out by this and the earlier study by Manakadan and Sivakumar (2004a). Yet another important area is Annamalaicherry at the southern end. Though part of the lagoon habitat, which is generally 'bird poor', Annamalaicherry supports high species richness and abundance of waterbirds due to a mix of micro-habitats created by various factors, and this is another site in Pulicat where the Greater Flamingo can be seen almost throughout the year. All these three areas need to be given special focus during the AWC to obtain better estimates of the bird population of Pulicat lake.

The northern areas of Pulicat are poor in bird diversity and only support populations in low densities during the North-east monsoon season, as they are shallow and remain dry for most of the summer. The southern lagoon part is deep and unattractive to most bird species, except for the margins and especially where uneven margins create micro-habitats attractive to birds as in the Annamalaicherry area. However, birds have to necessarily move to the lagoon areas as the northern and central areas of Pulicat lake dry up. The lagoon areas are also more attractive to duck species due to the abundance of aquatic vegetation, which the central and northern areas lack due to frequent drying and higher salinity.

As for the populations of waterbird species of Pulicat, it is difficult to arrive at estimates due to the vastness of the area, the difficult logistics involved in reaching most areas and the movements of birds primarily influenced by changing water regimes. AWC counts of the Pulicat lake area have ranged from a high of 83,806 in 1988 to lows of c. 10,000 in 1991 and 1992, but from our experience, we feel that most of these differences are more due to chance and the effort and areas covered rather than annual variations in populations. Most of the AWC exercises were along the Sriharikota-Sullurpet stretch of Pulicat lake due to the easy accessibility and bird concentrations during that period. Even here, counts

of waterbirds can vary considerably within a 2-week period depending on water levels, with the maximum number of birds expected when the drying stage creates a mosaic of shallow water, exposed flats and drying pools, with high concentrations of prey trapped in the shallows and the mudflats. Future waterfowl counts need to cover the Moolah Kuppam and Annamalaicherry areas to obtain better estimates of the bird populations of Pulicat.

Six species of Vulnerable or Near-Threatened species (classification of BirdLife International (2001)) occur in the Pulicat area. Of these, the Oriental Darter and the Black-bellied Tern are rare in the Pulicat area. The Lesser Flamingo is rare compared to the Great Flamingo in Pulicat Lake, but a high count of 3,000 birds was recorded in May 2007, which is more than 1% of the biogeographic population of this species (1,500 birds; Islam and Rahmani 2004), which makes Pulicat an important wintering site for this species. The populations of the Spot-billed Pelican (Vulnerable), Black-headed Ibis (Near-Threatened) and the Painted Stork (Near-Threatened), all of which breed in the heronries in the area, also significantly surpass their estimated 1% biogeographic population of 40, 100 and 100 birds, respectively. For these reasons alone, the Pulicat lake area easily qualifies for the status of a Ramsar Site.

There appear to have been some changes over the years in the population of some waterbird species in the Pulicat area, judging from the findings obtained by earlier workers and our study. However, definite conclusions cannot be arrived at, taking into account the areas covered and the time frame of these studies. Some of the very obvious changes are with regard to the Indian Reef-Heron and Osprey. Samant and Rao (1996) mentioned that 'up to five individuals' of the Indian Reef-Egret were recorded at a time in Pulicat lake. There was only a sighting of a bird during this project in the northern part of Pulicat; the species was not recorded by Manakadan and Sivakumar (2004a) during their 3-year study. However, Samant and Rao (1996) reported it to be fairly common in Pulicat lake from September to mid-March. The Osprey was reported to be common by Samant and Rao (1996), but only a pair was occasionally sighted from one site of Pulicat lake by Manakadan and Sivakumar (2004a) and only one bird was recorded on rare occasions during this study.

As for suspected and probable wrong cases of identification, there appears to be a confusion in separating the Indian Shag from the Little Cormorant. Perusing a list of birds handed over to the Nelapattu Forest Department by a birdwatchers group during the 2001-2002 breeding season, we found that all the nesting cormorants had been identified as the Little Cormorant, while except for half a dozen nests of this species that year, all the other 200-odd nests were

those of the Indian Shag. Perennou (1990) had also expressed doubts about confusion in identification between the Indian Shag and the Little Cormorant in India resulting in undercounts for the former in the AWC while considering his count of c. 1,200 Indian Shag in Nelapattu during the 1987-1988 breeding season. However, there also appear to be fluctuations in the nesting numbers of these two species as Philip *et al.* (1998) had counts of <3,000 Little Cormorant and only four Indian Shag in 1998, and during this study, the number of breeding Indian Shags was just a little less than that of Little Cormorant, in contrast to the earlier discussed 2001-2002 observation.

We are of the opinion that juveniles of the Brown-headed Gull (which do not have wing mirrors unlike adults) have got wrongly identified as the Common Black-headed Gull in Pulicat (and also in the Great Vedaranyam Swamp, Tamil Nadu) by earlier workers. The Common Black-headed Gull was described as very common during winters in Pulicat lake (BNHS 1977; Samant and Rao 1996) but was not recorded by Manakadan and Sivakumar (2004a), and also during this project. Ali and Ripley (1987) report the species to be more common on the western seaboard of peninsular India and also mention that published sight records are not free from ambiguity with the similar looking Brown-headed Gull. The second author, who worked in the Great Vedaranyam Swamp (GVS) for about 4 years during the 1980s, recorded the smaller Common Black-headed Gull only once as a large flock during the return migration period (Manakadan 1991), though it is reported to be a common species in some publications (Ali and Hussain 1981, 1982; Sugathan 1982). The species was also not reported by Natarajan (1992).

The Intermediate Egret was not recorded in Pulicat during this study, but a few birds were occasionally recorded in freshwater tanks. Manakadan and Sivakumar (2004a) too recorded the species only in freshwater habitats in Sriharikota but not in Pulicat. Samant and Rao (1996) state its distribution in Sriharikota Island to be 'rather uncommon in most waterbodies but often seen in good numbers towards February-March when individuals shift to the island from Pulicat'. It appears that in areas where there is an abundance of freshwater habitats, the Intermediate Egret will stick exclusively to such sites. The second author, who worked in the GVS for about four years during the 1980s, did not record the species there (Manakadan 1991), while earlier publications cite its occurrence (Ali and Hussain 1981, 1982; Sugathan 1982). All the birds recorded during the breeding season in the GVS were found to have plumes only on the back as in Great Egret (*vs.* back and breast in case of Intermediate Egret – *see* Ali and Ripley 1987).

Another likely case of wrong identification is the reported sighting of Pallas's Sea-Eagle *Haliaeetus leucorhynchus* during the 2004 AWC. We suspect this to be a misidentification of an immature White-bellied Sea-Eagle, which has a plumage similar to that of an adult Pallas's Sea-Eagle as we had also made the same assumption once. The confirmed southernmost record for the species is Chilika Lake, Orissa (Ali and Ripley 1987).

Waterbirds of Adjoining Wetlands

Species partial to freshwater habits are distributed over a number of freshwater habitats on the mainland and in the islands in Pulicat including Sriharikota. Among these, Kudiri Tank at the outskirts of Sullurpet is a very important wetland for waterbirds. The tank becomes especially attractive for waterbirds when Pulicat lake starts to dry up over large tracts towards the end of early February. The lake gets more or less filled by an assortment of birds till the migrants leave for their breeding grounds towards the end of March and the tank dries up in May/June. The wetlands in Sriharikota have become an important habitat, especially for freshwater bird species and also serve as a breeding site for waterfowl species after the island was taken over by ISRO as it is now almost free of human disturbance.

Realising the importance of the southern Kudiri Tank for the Spot-billed Pelican and other waterbird species during an earlier project, Manakadan and Kannan (2003) had recommended that the tank be taken over by the Forest Department and a part of it be developed as a breeding site for heronry species on the lines of Nelapattu. It is almost certain that birds will start breeding at this site once it is developed, judging from the new heronries that have got established in Sriharikota Island. We again recommend that the tank be taken over by the Forest Department (or the SDSC-SHAR). Kudiri Tank could also turn out to be a very important tourist attraction in the Pulicat area due to its easy accessibility as it is at the outskirts of Sullurpet and on the road to Sriharikota. Suggested conservation and development measures are:

1. Fencing of the tank to demarcate the boundary of the lake and protect it from encroachments.
2. Creating mounds in the tank planted with suitable nesting trees species (e.g., *Acacia nilotica* and *Barringtonia acutangula*). A few mounds should not be planted with trees so that they serve as resting and roosting sites for ducks, terns, pelicans, etc.
3. Deepening of the eastern and southern part of the tank, and adoption of a strategy for releasing water up to the tank's current capacity, and not the extra water obtained due to deepening, so as not to create conflicts

with locals for irrigation needs. The soil excavated for deepening the tank could be used for creating the mounds suggested under (2). As this tank is currently not of importance to fisheries unlike the deeper northern Kudiri Tank, conflicts with fishermen will not be a major issue. The western and northern part of the tank should not be deepened, and they may provide a habitat for shallow water-preferring bird species.

Heronries

The Pulicat lake area was known to have only three heronries till the end of the last century, all on the mainland, of which Nelapattu is the largest and most well known. Three more heronries were discovered during the beginning of this century in Sriharikota by Manakadan and Sivakumar (2004a). The six heronries in the Pulicat area support/supported 13 species of colonial waterbirds, namely, Little Cormorant, Indian Shag, Spot-billed Pelican, Little Egret, Grey Heron, Great Egret, Intermediate Egret, Eastern Cattle Egret, Black-crowned Night-Heron, Painted Stork, Asian Openbill, Black-headed Ibis and Eurasian Spoonbill. Given below is an account of the heronries in the Pulicat area.

Nelapattu

Eight heronry species were recorded breeding in Nelapattu during the study period: Little Cormorant, Indian Shag, Spot-billed Pelican, Little Egret, Eastern Cattle Egret, Black-crowned Night-Heron, Asian Openbill and Black-headed Ibis. The Eurasian Spoonbill was not recorded to breed at Nelapattu during this study and during our earlier studies (since 2000) though a few birds arrived each year during the breeding season. As for past breeding records of the species, Santharam (unpublished data) recorded it nesting in small numbers at Nelapattu in the early 1980s, and Ramakrishna (1990) had reported three or four nests in Vedurupattu-Edhirpattu. More than 500 pairs of Spot-billed Pelican were recorded breeding during the 2005-2006 and 2006-07 breeding seasons, these numbers being much higher than those recorded during 2004-2005 and during an earlier 3-year project (Manakadan and Kannan 2003), when around 250 pairs nested annually.

The Nelapattu Heronry is well protected, and the Forest Department has been taking up activities for the development and conservation of the heronry. The main problem now facing Nelapattu is from tourist activity – though the birds are apparently unaffected, judging from the nesting success. The influx of tourists is extremely high (in the thousands) during the annual Flamingo Festival organised by the Tourism Department in collaboration with other governmental departments. A lot of noise and litter is

generated during the festival. Probably, the barrier of water and the densely vegetated walkway considerably reduce the disturbance by tourists. Another conservation issue that will be especially relevant in the future will be the need to have more nesting trees to accommodate the increase in nesting birds taking into account the breeding success each year. An alternative would be to develop an additional heronry, like the Kudiri Heronry suggested earlier.

Tada (Bolegalupadu)

Breeding did not take place in the Tada (Bolegalupadu) Heronry during the 2004-05 breeding season, but took place during the 2005-2006 and 2006-2007 seasons, with five pairs of Grey Heron breeding each year. Around the same number of herons along with about 25 pairs of Little Cormorant were recorded breeding in the heronry during 2002 by us. The future of the heronry is bleak, with only one of the three nesting trees remaining and even this tree facing pressures from the houses that have come up, right under it. The new heronries in Sriharikota are probably constituted by birds that have abandoned the Tada and Vedurupattu-Edirpattu heronries – see below.

Vedurupattu-Edirpattu Heronry

Breeding did not take place in the Vedurupattu-Edirpattu Heronry during the 2004-05 and 2006-07 breeding seasons, but 20 nests of Painted Stork and 15 nests of Little Egret were recorded during the 2005-2006 breeding season. No direct threats face the Vedurupattu-Edirpattu Heronry, except that it appears that most of the birds have shifted to the new heronries in Sriharikota Island, probably due to better nesting and foraging conditions available in the Sriharikota area. The Vedurupattu-Edirpattu Heronry had earlier supported around 200 breeding pairs of Painted Stork (see species account). As for earlier breeding records of other species, Perennou and Santharam (1990) had recorded 92 nests of the Little Cormorant, 13 nests of the Grey Heron and 20 nests of the Little Egret. A few cases of nesting of the Spot-billed Pelican were also reported

(Ramakrishna 1990; Santharam 1998). Considering these above mentioned factors and since the future of village based heronries is more prone to risks compared to those in protected areas (Manakadan and Kannan 2003), we do not offer recommendations for the conservation of this heronry.

Sriharikota Heronries

Information on the discovery of the three heronries in Sriharikota Island (Madugu, Beripeta and Karimanal) and their breeding birds and site conditions have already been published elsewhere (Sivakumar and Manakadan 2005). Together, these heronries were recorded to have around 300 nests of the Little Cormorant, 150 nests of the Little Egret, 6 nests of the Great Egret, 1 nest of the Intermediate Egret, 18 nests of the Grey Heron, and 200+ nests of the Painted Stork. The Beripeta Heronry is now the major heronry for the Painted Stork, which in all likelihood comprises of birds that used to breed in the Vedurupattu-Edirpattu Heronry. The three heronries in Sriharikota are relatively well protected and face little human related pressures, especially for the past few years, as Sriharikota is a high-security zone and the authorities of the SDSC-SHAR being keen to conserve and develop the heronries. SDSC-SHAR is developing the Beripeta Heronry on the lines of Nelapattu (on our recommendations) and such positive developments could also be expected to take place for the other two heronries in future.

ACKNOWLEDGEMENTS

We thank the Ministry of Environment & Forests, Government of India for funding the study and the Andhra Pradesh Forest Department for giving permission to work in the area and for generous cooperation and help. We thank a number of members of the Madras Naturalists' Society for providing help in various ways. We also thank the ISRO authorities at the SDSC-SHAR Centre, Sriharikota for providing us the necessary permission and other facilities for our stay and work in Sriharikota during the other projects.

REFERENCES

- ALI, S. & S.A. HUSSAIN (1981): Studies on the movement and population structure of Indian avifauna. Annual Report (1980-1981). Bombay Natural History Society, Bombay. Pp. 141.
- ALI, S. & S.A. HUSSAIN (1982): Studies on the movement and population structure of Indian avifauna. Annual Report (1981-1982). Bombay Natural History Society, Bombay. Pp. 139.
- ALI, S. & S.D. RIPLEY (1987): Compact Handbook of the Birds of India and Pakistan together with those of Bangladesh, Nepal, Bhutan and Sri Lanka. 2nd Edition. Oxford University Press, Delhi.
- ANON (1908): The Imperial Gazetteer of India Vols. IX: 32-33, XX: 242, XXIII: 98. Clarendon Press, Oxford.
- ANON (1993): Directory of Indian Wetlands. WWF-India, New Delhi. Pp. 182-184.
- BALACHANDRAN, S. (1998): Bird Migration Studies in India (1980-1992). Final Report. Phase I & II. Bombay Natural History Society, Mumbai. Pp. 142.
- BIRDLIFE INTERNATIONAL (2001): Threatened Birds of Asia: The BirdLife International Red Data Book. Part A. Cambridge, UK. BirdLife International. 852 pp.
- BLASCO, F. & P. LEGRIS (1973): Dry evergreen forest of Point Calimere and Marakanam. *J. Bombay Nat. Hist. Soc.* 70: 279-294.
- BNHS (1977): Birds of Sriharikota Island. A preliminary survey by the

- BNHS submitted to ISRO. Bombay Natural History Society, Mumbai.
- CHACKO, P.I., J.G. ABRAHAM & R. ANDAL (1953): Report on the survey, fauna and fisheries of the Pulicat Lake. Madras State India, 1951-52. *Contr. Freshwater Fish. Biol. Stat. Madras* 8: 20.
- HORNELL, J. (1908): Report on the suitability of Pulicat Lake for oyster culture. *Madras. Fish. Bull.* 4: 1-23.
- ISLAM, M.Z. & A.R. RAHMANI (2004): Important Bird Areas in India: Priority Sites for Conservation. Bombay Natural History Society and BirdLife International.
- JOEL, D.R. (1973): Studies on the biology and fisheries of the edible protunid crabs of the Pulicat Lake. Ph.D. Thesis. University of Madras.
- KALIYAMURTHY, M. (1972): Observations on the food and feeding habits of some fishes of the Pulicat Lake. *Inland Fish. Rec. India* 4: 115-121.
- KALIYAMURTHY, M. (1973): Observations on the transparency of the waters of the Pulicat Lake with particular reference to plankton production. *Hydrobiologica*. 41(1): 3-11.
- KALIYAMURTHY, M. (1974): Observations on the environmental characteristics of Pulicat Lake. *J. mar. biol. Ass. India* 16 (3): 683- 688.
- KANNAN, V. & R. MANAKADAN (2005): The status, distribution and population of the Spot-billed Pelican *Pelecanus philippensis* in southern India. *Forktail* 21: 9-14.
- KASAPPA, R.V. (1991): Working plan for the forests of Nellore district (1991-1992). Andhra Pradesh Forest Department, Nellore.
- KRISHNAMURTHY, K.N. (1971): Preliminary studies on the bottom biota of Pulicat Lake. *J. mar. biol. Ass. India*. 13 (1&2): 264-269.
- KRISHNAN, M. (1990): List of birds seen at Tada (Pulicat) Lake Sanctuary and Nelapattu Sanctuary, A.P., on 28 Nov and 20-21 Dec. 1983 by the BNHS Project Scientist of their Avifauna Project, S.A. Hussain. *Mayura* 7&8: 39-41.
- MANAKADAN, R. (1992): Ecology of waterbirds of Point Calimere Wildlife Sanctuary with special reference to impact of salt works. Ph.D. thesis. Bombay University, Bombay. Pp. 178.
- MANAKADAN, R. & V. KANNAN (2003): A study of the Spot-billed Pelican *Pelecanus philippensis* Gmelin in southern India with special reference to its conservation. Bombay Natural History Society, Mumbai. Pp. 78.
- MANAKADAN, R. & V. KANNAN (2007): An ecological account of the waterbirds of Pulicat Lake with special reference to conservation. Final Report. Bombay Natural History Society. Pp. 61.
- MANAKADAN, R. & S. SIVAKUMAR (2004a): An ecological account of faunal diversity of Sriharikota Island and its environs. Final Report: Part I - Birds and Mammals. Bombay Natural History Society, Mumbai. Pp. 46.
- MANAKADAN, R. & S. SIVAKUMAR (2004b): Sighting of the Water Rail *Rallus aquaticus* in Sriharikota Island, Nellore district, Andhra Pradesh. *Newsletter for Ornithologists* 1(1&2): 15-16.
- MOHAPATRA, K.K. & P. RAO (1992): Some wader records from coastal Andhra Pradesh. *J. Bombay Nat. Hist. Soc.* 89(2): 250-251.
- MOHAPATRA, K.K. & P. RAO (1993): Occurrence of the Knot *Calidris canutus* in Andhra Pradesh, India *J. Bombay Nat. Hist. Soc.* 90: 509.
- MOHAPATRA, K.K. & P. RAO (1994): Winter migrants seen at Pulicat Bird Sanctuary and Sriharikota Island during 1989-90 and 1990-91 seasons. *Mayura* 11: 9-11.
- NATARAJAN, V. (1992): Wintering waterbirds at Point Calimere, Tamil Nadu. *J. Bombay Nat. Hist. Soc.* 89(2): 316-320.
- NAGULU, V. (1983): Feeding and breeding biology of Grey Pelican at Nelapattu Bird Sanctuary in Andhra Pradesh, India. Ph.D. thesis. Osmania University, Hyderabad. Pp. 161.
- OSWIN, S.D. (1987): A report on Pulicat Lake. PREPARE, Madras.
- PANINI, D. (1996): Rethinking wetland laws. A case study of Pulicat Bird Sanctuary. Occasional Paper Series. Center for Environmental Law, WWF-India, New Delhi.
- PAUL RAJ, R. (1976): Studies on the penaeid prawns of Pulicat Lake, South India. Ph.D. Thesis, University of Madras, Madras.
- PERENNOU, C. (1990): Some comments on the Indian Waterfowl Counts, 1987 and 1988. *Wetlands and Waterfowl Newsletter* 2: 17-24.
- PERENNOU, C. & V. SANTHARAM (1990): An ornithological survey of some wetlands in south-east India. *J. Bombay Nat. Hist. Soc.* 87: 354-363.
- PHILIP, V.M. (1995): Birds of Pulicat Lake and Kingfishers lured to death. *Newsletter for Birdwatchers* 35(3): 45-47.
- PHILIP, V.M., A.N.J. RAO & B.N. SRIDHAR (1998): Birding at Nelapattu and Vedurupattu bird refuges, Andhra Pradesh. *Newsletter for Birdwatchers* 38(1&2): 1-3.
- PUNJABI, H. (1997): Sighting of Water Rail *Rallus aquaticus* near Mumbai. *J. Bombay Nat. Hist. Soc.* 94:156.
- RAMAKRISHNA, C. (1990): Vedurupattu-Painted Stork *Mycteria leucocephala* nesting place. *Mayura* 7&8(1-4): 34-35.
- RAMAKRISHNA, C. (1996): Edhirpattu - A home for the Painted Storks. *Blackbuck* 2(2): 25-26.
- RAMAN, K., M. KALIYAMURTHY & K.O. JOSEPH (1977): Observations on the ecology and fisheries of the Pulicat Lake during drought and normal periods. *J. Mar. Biol. Ass. India*. 19(1): 16-20.
- RAMESH, P. (1994): Pulicat Lagoon, Is conversion of this lagoon to freshwater reservoir possible - An analysis. Centre for Water Resources, Anna University, Madras.
- RAO, P. (1998): The bird communities of the Tropical Dry Evergreen Forests of Sriharikota. Ph.D. Thesis. University of Bombay, Bombay. Pp. 176.
- RAO, P. & K.K. MOHAPATRA (1992): Biometrics of the Collared Pratincole *Glareola pratincola maldivarum*. *J. Bombay Nat. Hist. Soc.* 89(2): 248-250.
- RAO, P. & K.K. MOHAPATRA (1993a): The wetland avifauna of Pulicat Bird Sanctuary, South India. Pp. 12-14. In: Verghese A., S. Sridhar & A.K. Chakaravarthy (Eds): Bird Conservation: Strategies for the Nineties and Beyond: Ornithological Society of India, Bangalore.
- RAO, P. & K.K. MOHAPATRA (1993b): Occurrence of the Lesser Frigate bird *Fregata minor* in Andhra Pradesh, India. *J. Bombay Nat. Hist. Soc.* 90: 284.
- RAO, P. & K.K. MOHAPATRA (1993c): Further evidence on the Black Tern *Chlidonias niger* on India's eastern coast. *J. Bombay Nat. Hist. Soc.* 90: 511.
- RAO, P. & K.K. MOHAPATRA (1994): Occurrence of certain bird species in and around Pulicat Bird Sanctuary. *Mayura* 11: 6-8.
- RASMUSSEN, P.C. & J.C. ANDERTON (2005): Birds of South Asia. The Ripley Guide. Vols. 1 and 2. Smithsonian Institution and Lynx Edicions, Washington, D.C. and Barcelona. 157 pp.
- SAMANT, J.S. & P. RAO (1996): An ecological investigation of the avian community of Sriharikota Island. Final Report. Bombay Natural History Society, Bombay. Pp. 45.
- SANJEEVA RAJ, P.J. (1995-96): Ecological and economical analysis of biodiversity loss in Pulicat Lake. Center for Research on New International Economic Order.
- SANJEEVA RAJ, P.J. (1996): Restoration of mangroves in Pulicat Lake. In: Conservation and Regeneration of Mangroves in South Asia. South Asia Network for Small Fisherfolk Development & Asian Cultural Forum on Development, Chennai.
- SANTHARAM, V. (1982): Some rare encounters. *Newsletter for Birdwatchers* 22(5-6): 5-8.
- SANTHARAM, V. (1989): On the occurrence and status of Ringed Plover *Charadrius hiaticula* (Lowe) in Madras city (southern India). *J. Bombay Nat. Hist. Soc.* 86(1): 101-102.

- SANTHARAM, V. (1993): Nelapattu – Time to sound the alarm. *Mayura* 10: 34-35.
- SANTHARAM, V. (1998): An evening at Vedurupattu. *Blackbuck* 14: 9-13.
- SCOTT, D.A. (1989): A Directory of Asian Wetlands. IUCN, The World Conservation Union, Gland, Switzerland.
- SHARMA, P.K. & P.S. RAGHAVAIAH (2000): Breeding of Painted Storks at Vedurupattu, Nellore district, Andhra Pradesh: Coexistence of man and wildlife. *Indian Forester* 126(10): 1147-1149.
- SHARMA, P.K. & P.S. RAGHAVAIAH (2002): Effect of rainfall on Grey Pelican (*Pelecanus philippensis*) arriving and breeding at Nelapattu Bird Sanctuary, Andhra Pradesh. *Indian Forester* 128(10): 1101-1105.
- SIVAKUMAR, S. & R. MANAKADAN (2005): An account of the heronries and other breeding waterbirds of Sriharikota, Andhra Pradesh, India, 93-96. Proc. National Seminar on Bird Ecology and Conservation. NLBW and INCERT, Bangalore.
- SRINIVASAN, A. & K.V.N. PILLAY (1972): Hydrology of the Pulicat Lake. 60-66. Proc.: Seminar Maricult. Mech. Fish, Madras, 28-29 Nov. 1992.
- SUBRAMANYA, S. (1996a): Distribution, status and conservation of Indian heronries. *J. Bombay Nat. Hist. Soc.* 93: 459-486.
- SUBRAMANYA, S. (1996b): Heronries of Andhra Pradesh. *Mayura* 13: 1-27.
- SUGATHAN, R. (1982): Some interesting aspects of the avifauna of the Point Calimere Sanctuary, Thanjavur District, Tamil Nadu. *J. Bombay Nat. Hist. Soc.* 79(3): 567-575.
- SURYANARAYANA, B., A.S. RAO, A.M. RAO & V. VEERARAJU (1989): Report on the flora of Sriharikota Island. 2 Volumes. Visvodaya Government College, Venkatagiri and SHAR Centre, Sriharikota.
- SURYANARAYANA, B., A.S. RAO, A.M. RAO & V. VEERARAJU (1998): Flora of Sriharikota Island. Technical Report: ISRO-SHAR-TR-99-98. Indian Space Research Organisation, Bangalore. Pp. 203.
- THANGAVELU, R. (1983): Eco-physiology of the edible oyster *Crassostrea madrasensis* (Preston) from the Pulicat Lake, south India. Ph.D.Thesis, University of Madras, Madras.
- VAZ, G.G. & P.K. BANERJEE (1997): Middle and late Holocene sea level changes in and around Pulicat Lagoon, Bay of Bengal, India. *Marine Geology* 138: 261-271.

